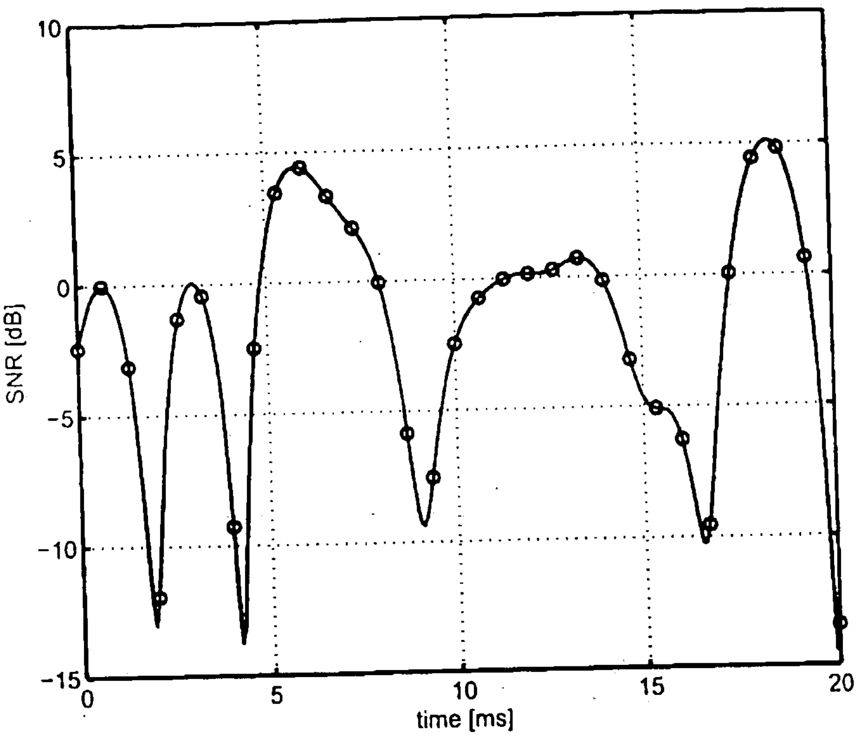

Fig. 1

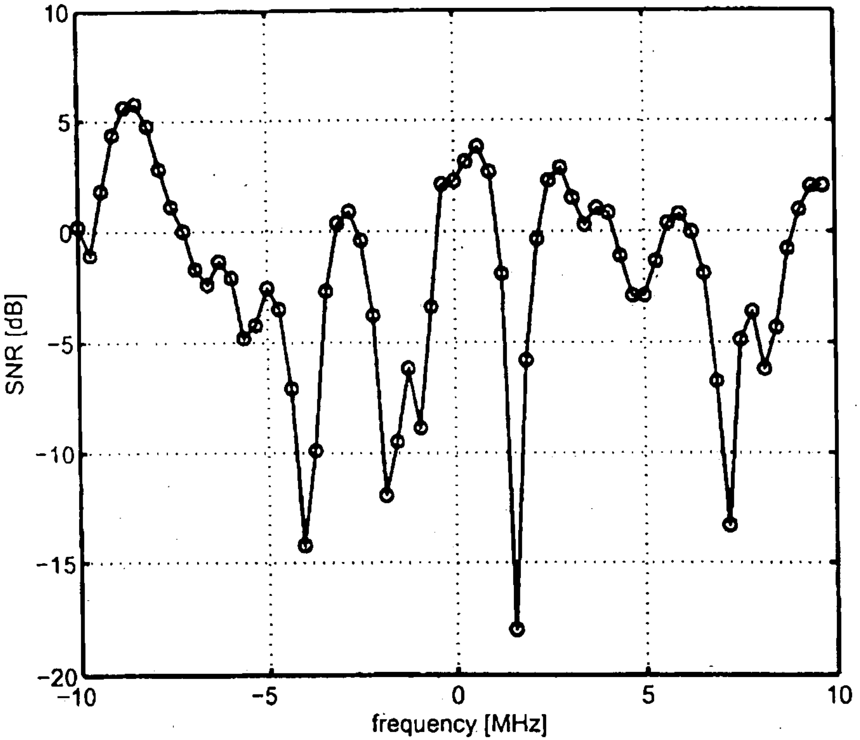

Fig. 2

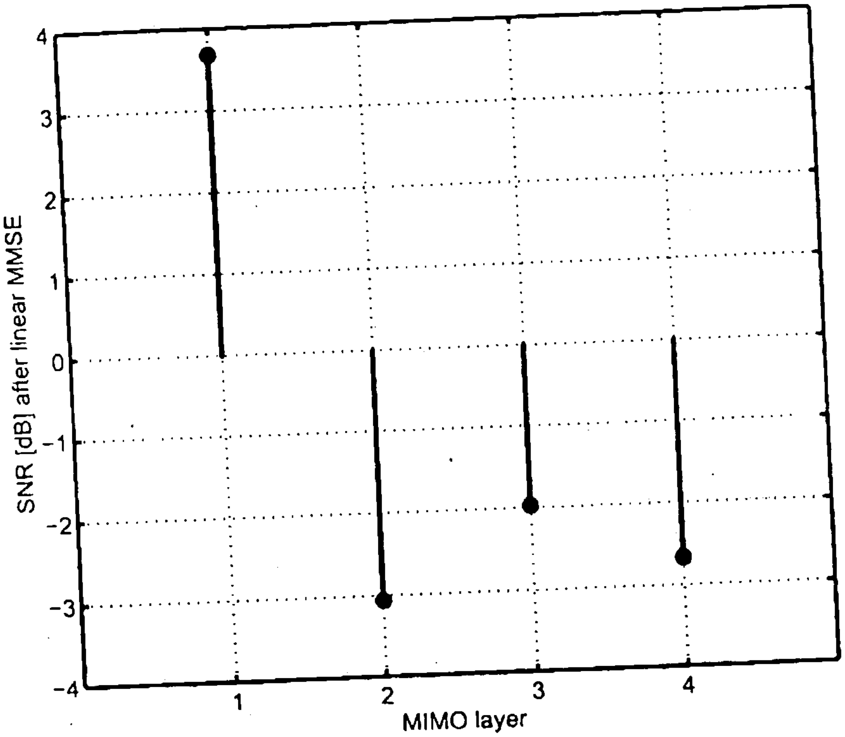

Fig. 3

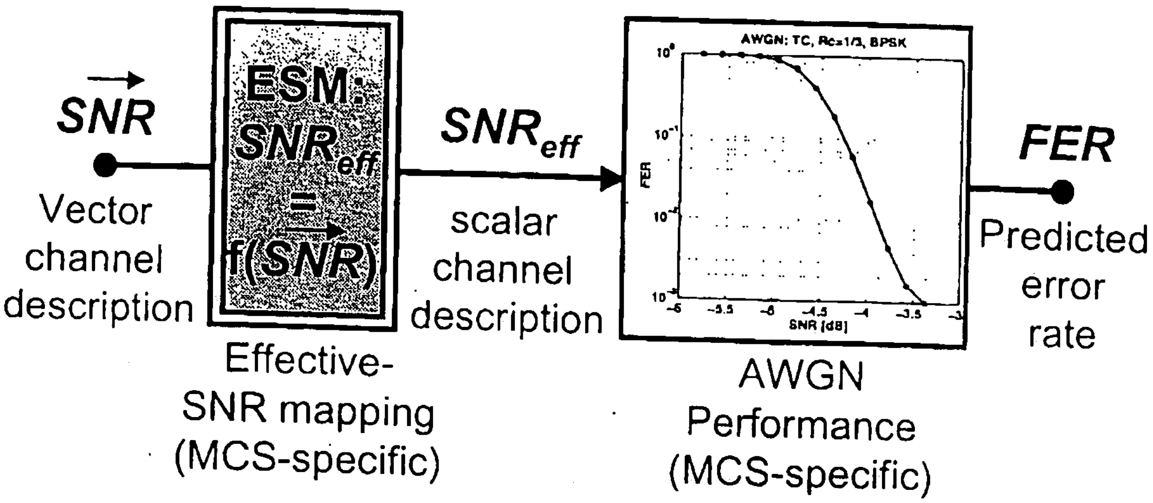
$\overrightarrow{SNR}$
Vector channel description
ESM: $SNR_{eff} = f(\overrightarrow{SNR})$
Effective-SNR mapping (MCS-specific)
SNR_{eff}
scalar channel description
AWGN: TC, Rc=1/3, BPSK
FER
10^0
10^{-1}
10^{-2}
10^{-3}
-6
-5.5
-5
-4.5
-4
-3.5
-3
SNR [dB]
AWGN Performance (MCS-specific)
FER
Predicted error rate

Fig. 4

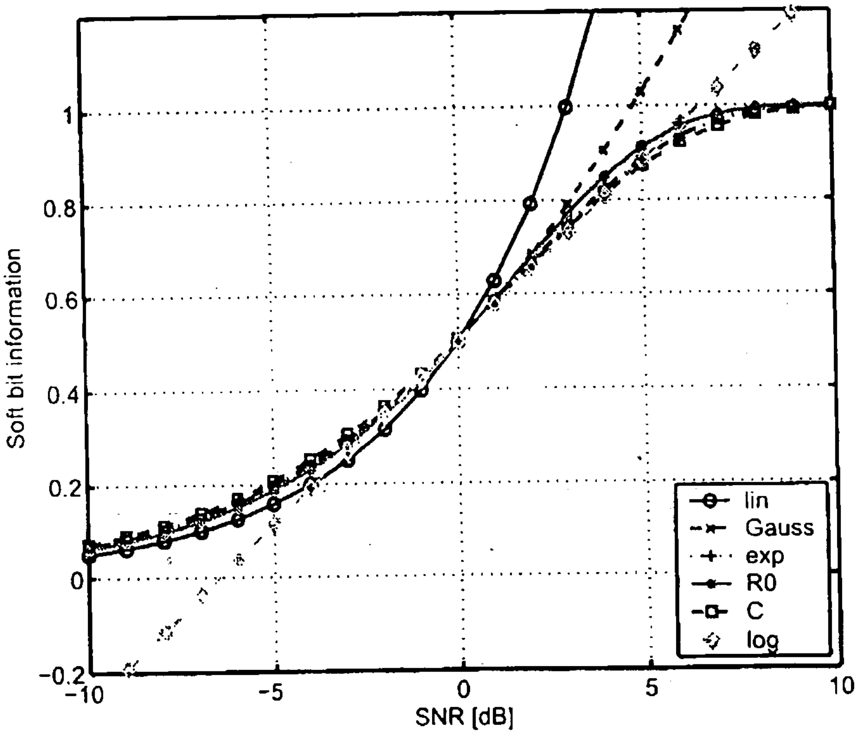
Soft bit information
SNR [dB]
1
0.8
0.6
0.4
0.2
0
−0.2
−10
-5
0
5
10
lin
Gauss
exp
R0
C
log

Fig. 5

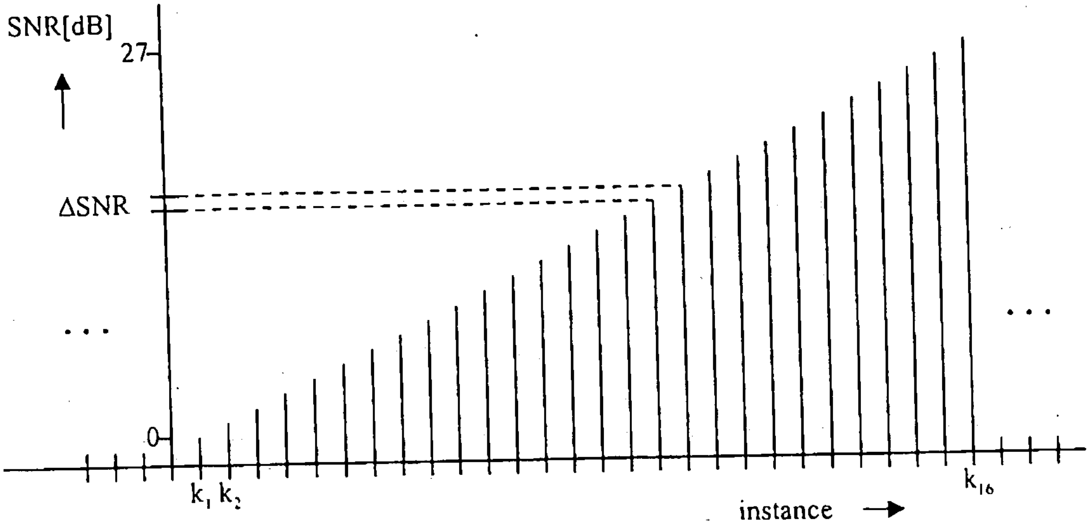

Fig.6

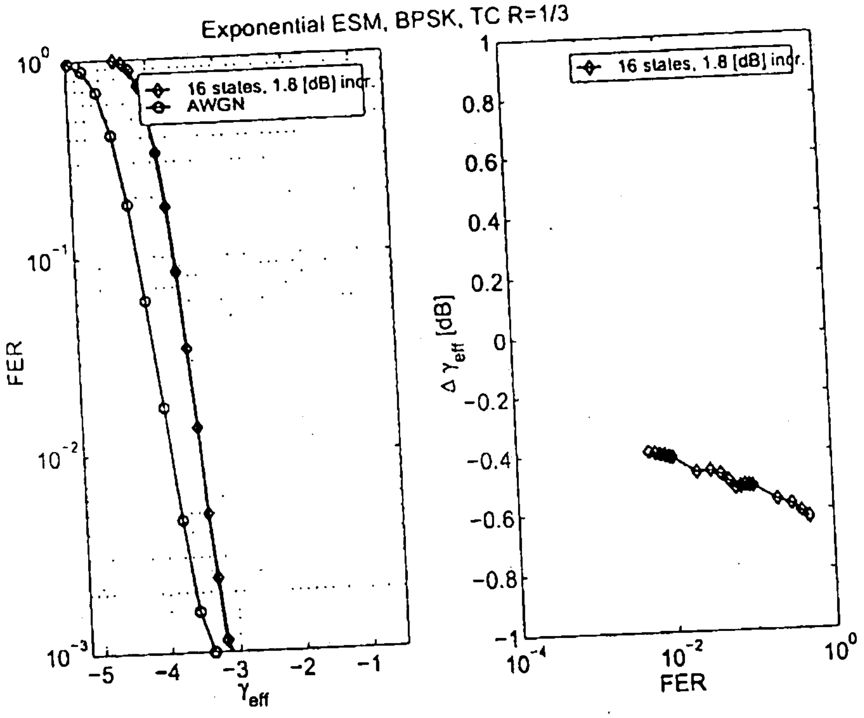
Exponential ESM, BPSK, TC R=1/3
16 states, 1.8 [dB] incr.
AWGN
10^0
10^{-1}
10^{-2}
10^{-3}
FER
-5
-4
-3
-2
-1
γ_{eff}
16 states, 1.8 [dB] incr.
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
$\Delta\ \gamma_{eff}$ [dB]
10^{-4}
10^{-2}
10^0
FER

Fig.7

Modulation Scheme	γ_{mod} [dB]
BPSK	0
QPSK	3
16QAM	≈ 8

Fig. 8

Exponential ESM, BPSK, TC R=1/3, γ_{cod}=-1 [dB]

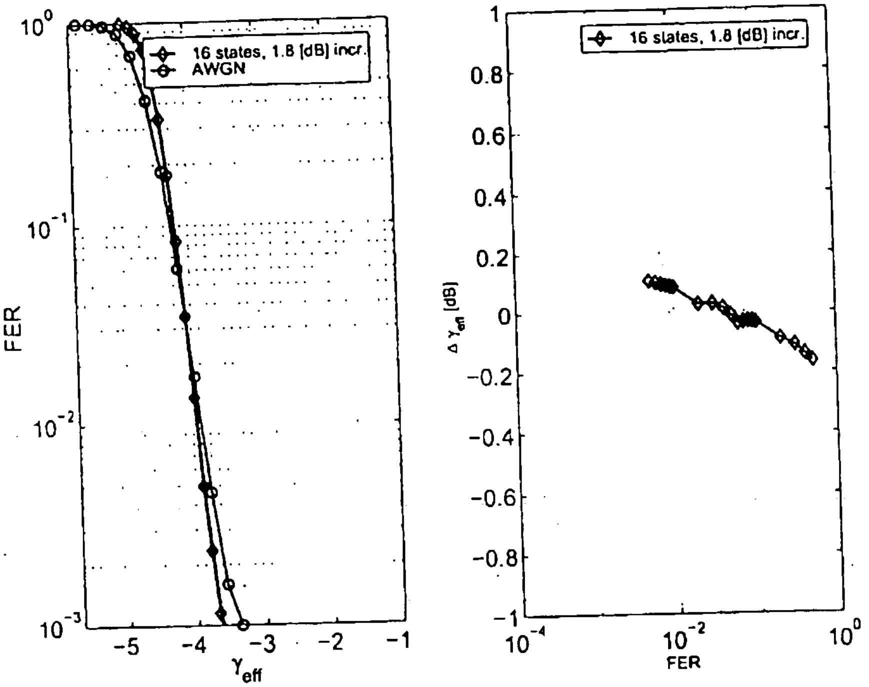

Fig. 9

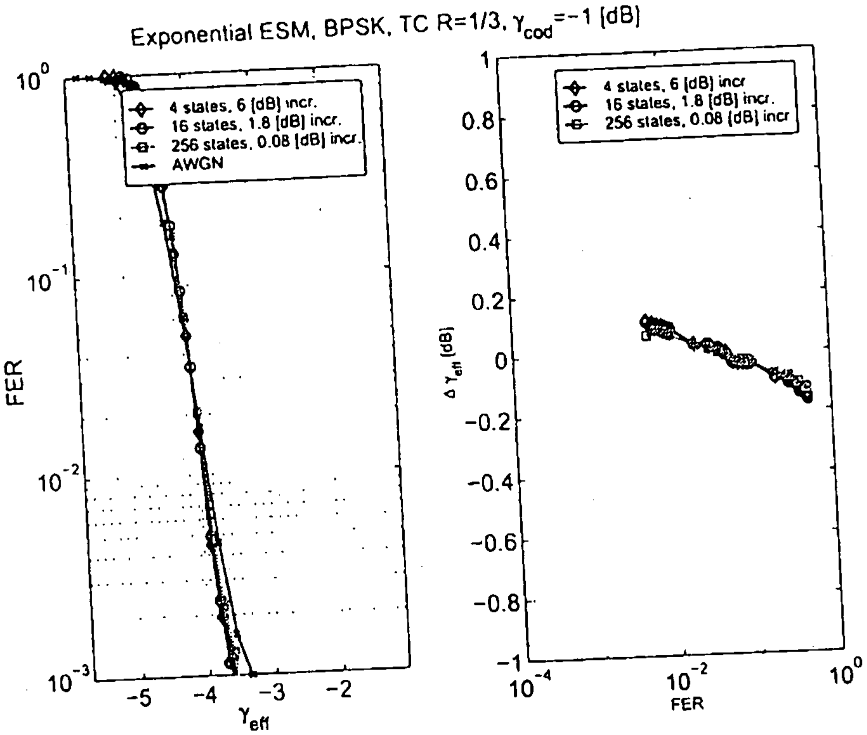
Exponential ESM, BPSK, TC R=1/3, γcod=-1 [dB]
FER
10^0
10^-1
10^-2
10^-3
-5
-4
-3
-2
γeff
4 states, 6 [dB] incr.
16 states, 1.8 [dB] incr.
256 states, 0.08 [dB] incr.
AWGN
Δ γeff [dB]
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
10^-4
10^-2
10^0
FER
4 states, 6 [dB] incr
16 states, 1.8 [dB] incr.
256 states, 0.08 [dB] incr

Fig. 10

MCS	Code	Modulation Scheme	γ_{mod} [dB]	γ_{cod} [dB]
1	TC R=1/3	BPSK	0	-1
7	TC R=1/3	QPSK	3	-1
9	TC R=1/3	16QAM	8	-2
8	TC R=1/2	BPSK	0	-1
12	TC R=1/2	QPSK	3	-1
5	TC R=4/5	QPSK	3	-0.45
3	CC R=1/8	QPSK	3	-0.3
13	CC R=1/3	BPSK	0	-0.6
2	CC R=1/3	QPSK	3	-0.6
10	CC R=1/3	16QAM	8	0.6
11	CC R=1/2	BPSK	0	-0.4
4	CC R=1/2	QPSK	3	-0.4
6	CC R=1/2	16QAM	8	+1.5

Fig. 11

Channel	Number of States	ΔSNR [dB]
MS1	16	1.8
MS2	4	6
MS3	256	0.08
MS4	27	0.8
MS5	2	1
MS6	2	5
MS7	2	10
MS8	4	1
MS9	4	3
MS10	9	0.1
MS11	9	1
MS12	9	3
MS13	9	5
MS14	270	0.07

Fig. 12

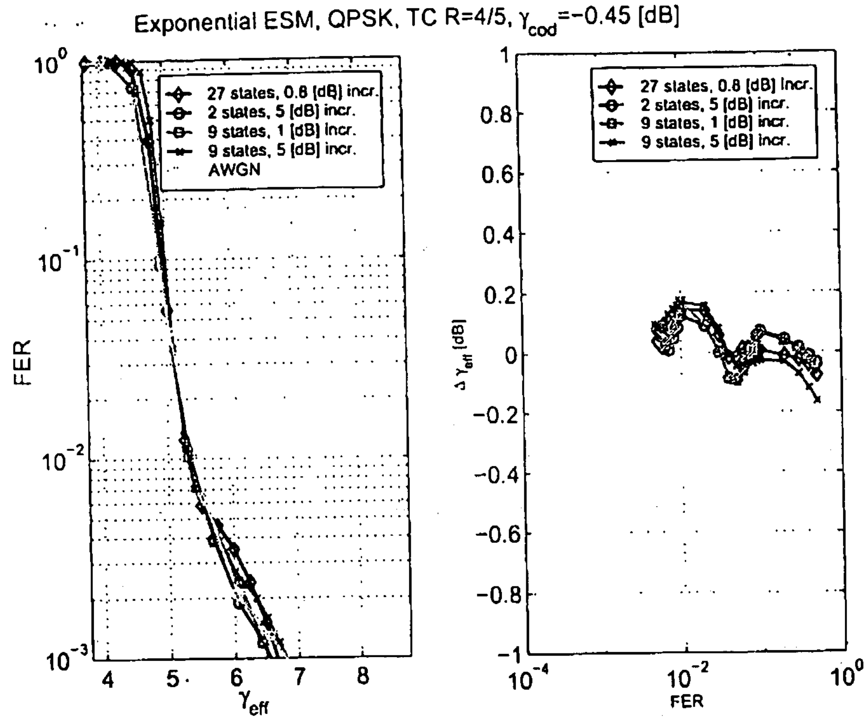
Exponential ESM, QPSK, TC R=4/5, γ_{cod}=-0.45 [dB]
FER
10^0
10^{-1}
10^{-2}
10^{-3}
4
5
6
7
8
γ_{eff}
27 states, 0.8 [dB] incr.
2 states, 5 [dB] incr.
9 states, 1 [dB] incr.
9 states, 5 [dB] incr.
AWGN
$\Delta\gamma_{eff}$ [dB]
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
10^{-4}
10^{-2}
10^0
FER
27 states, 0.8 [dB] incr.
2 states, 5 [dB] incr.
9 states, 1 [dB] incr.
9 states, 5 [dB] incr.

Fig. 13

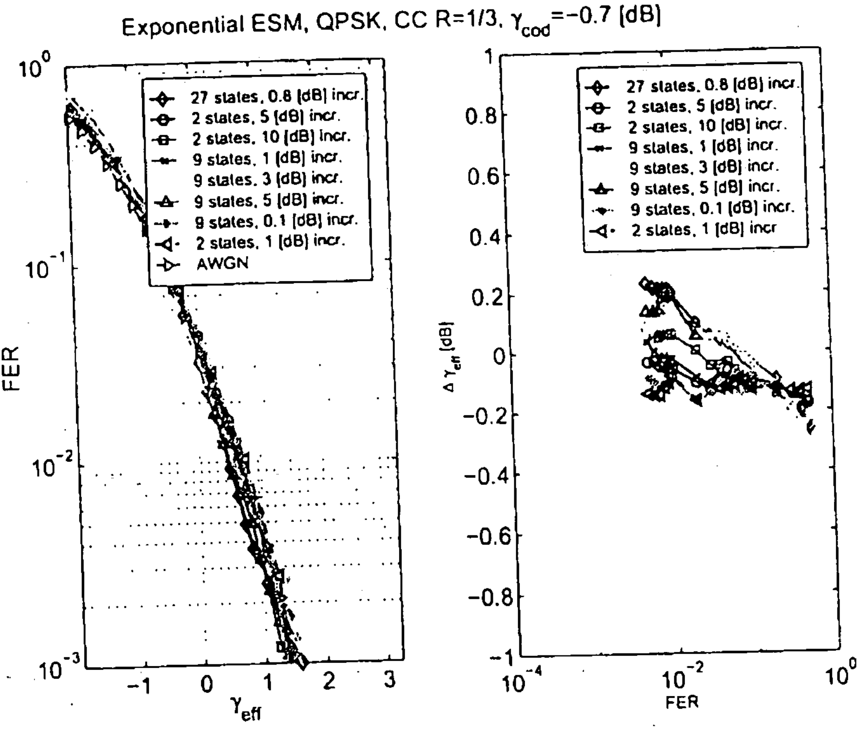
Exponential ESM, QPSK, CC R=1/3, γ_{cod}=-0.7 [dB]
27 states, 0.8 [dB] incr.
2 states, 5 [dB] incr.
2 states, 10 [dB] incr.
9 states, 1 [dB] incr.
9 states, 3 [dB] incr.
9 states, 5 [dB] incr.
9 states, 0.1 [dB] incr.
2 states, 1 [dB] incr.
AWGN
FER
10^{0}
10^{-1}
10^{-2}
10^{-3}
-1
0
1
2
3
γ_{eff}
$\Delta\gamma_{eff}$ [dB]
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
10^{-4}
10^{-2}
10^{0}
FER

Fig. 14

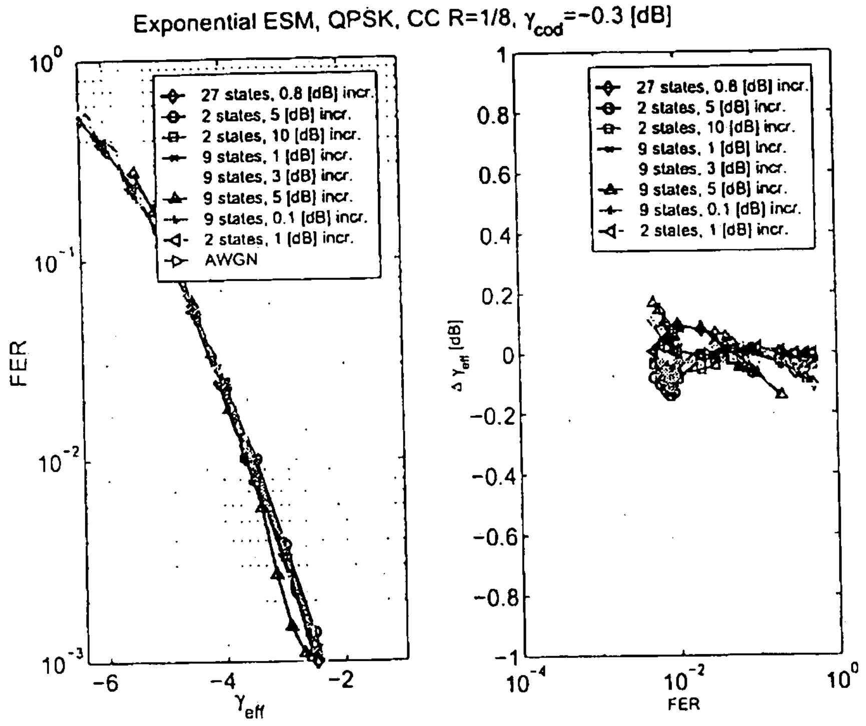
Exponential ESM, QPSK, CC R=1/8, γ_{cod}=-0.3 [dB]
FER
10^0
10^{-1}
10^{-2}
10^{-3}
-6
-4
-2
γ_{eff}
27 states, 0.8 [dB] incr.
2 states, 5 [dB] incr.
2 states, 10 [dB] incr.
9 states, 1 [dB] incr.
9 states, 3 [dB] incr.
9 states, 5 [dB] incr.
9 states, 0.1 [dB] incr.
2 states, 1 [dB] incr.
AWGN
$\Delta\gamma_{eff}$ [dB]
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
10^{-4}
10^{-2}
10^0
FER
27 states, 0.8 [dB] incr.
2 states, 5 [dB] incr.
2 states, 10 [dB] incr.
9 states, 1 [dB] incr.
9 states, 3 [dB] incr.
9 states, 5 [dB] incr.
9 states, 0.1 [dB] incr.
2 states, 1 [dB] incr.

Fig. 15

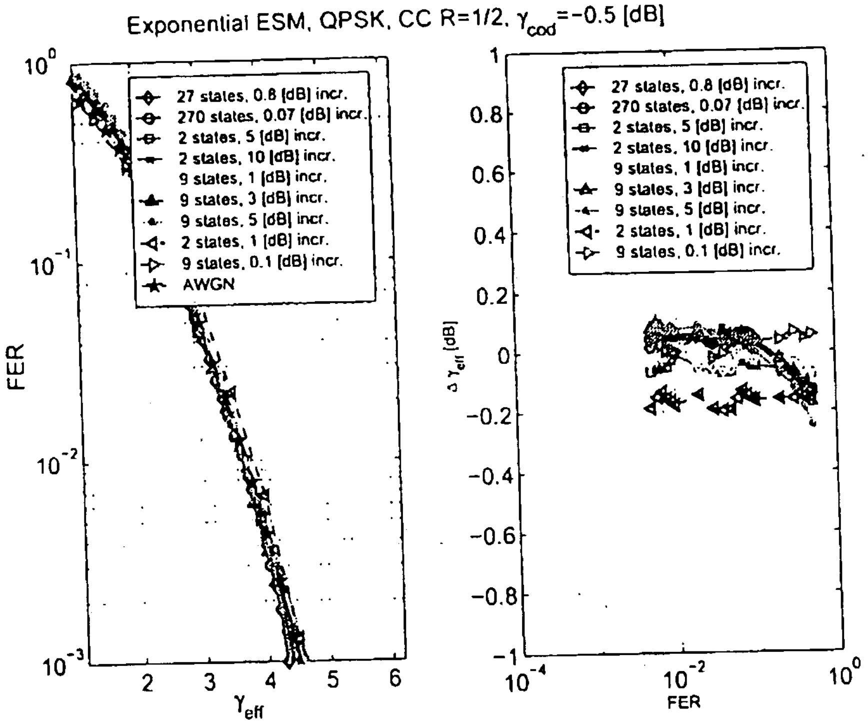
Exponential ESM, QPSK, CC R=1/2, γ_{cod}=-0.5 [dB]
FER
10^0
10^{-1}
10^{-2}
10^{-3}
2
3
4
5
6
γ_{eff}
27 states, 0.8 [dB] incr.
270 states, 0.07 [dB] incr.
2 states, 5 [dB] incr.
2 states, 10 [dB] incr.
9 states, 1 [dB] incr.
9 states, 3 [dB] incr.
9 states, 5 [dB] incr.
2 states, 1 [dB] incr.
9 states, 0.1 [dB] incr.
AWGN
$\Delta\gamma_{eff}$ [dB]
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
10^{-4}
10^{-2}
10^0
FER
27 states, 0.8 [dB] incr.
270 states, 0.07 [dB] incr.
2 states, 5 [dB] incr.
2 states, 10 [dB] incr.
9 states, 1 [dB] incr.
9 states, 3 [dB] incr.
9 states, 5 [dB] incr.
2 states, 1 [dB] incr.
9 states, 0.1 [dB] incr.

Fig. 16

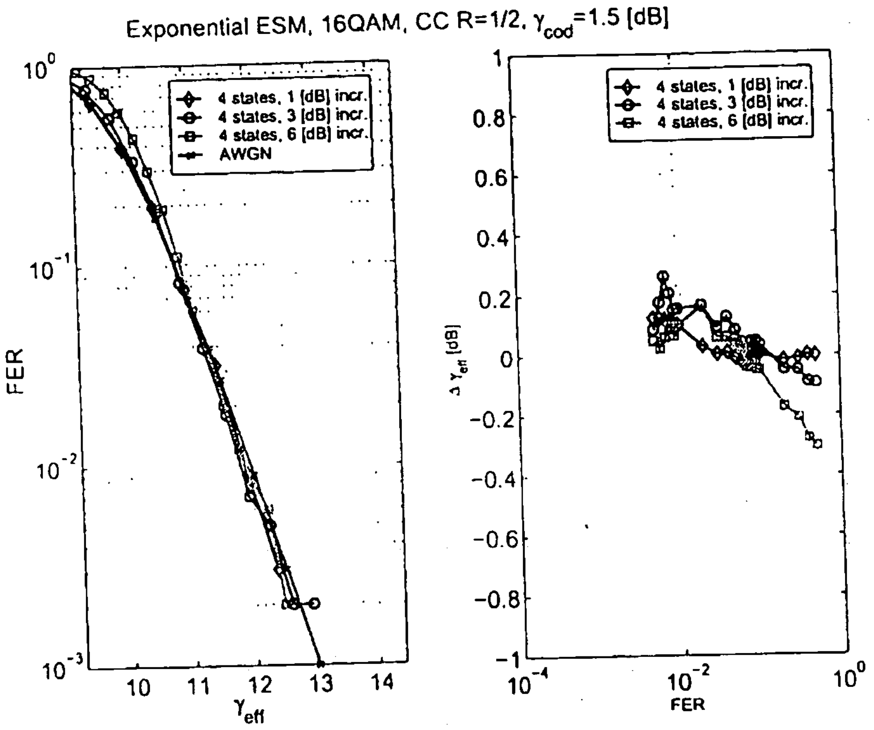
Exponential ESM, 16QAM, CC R=1/2, γ_{cod}=1.5 [dB]
FER
10^0
10^{-1}
10^{-2}
10^{-3}
10
11
12
13
14
γ_{eff}
4 states, 1 [dB] incr.
4 states, 3 [dB] incr.
4 states, 6 [dB] incr.
AWGN
$\Delta\gamma_{eff}$ [dB]
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
10^{-4}
10^{-2}
10^0
FER
4 states, 1 [dB] incr.
4 states, 3 [dB] incr.
4 states, 6 [dB] incr.

Fig. 17

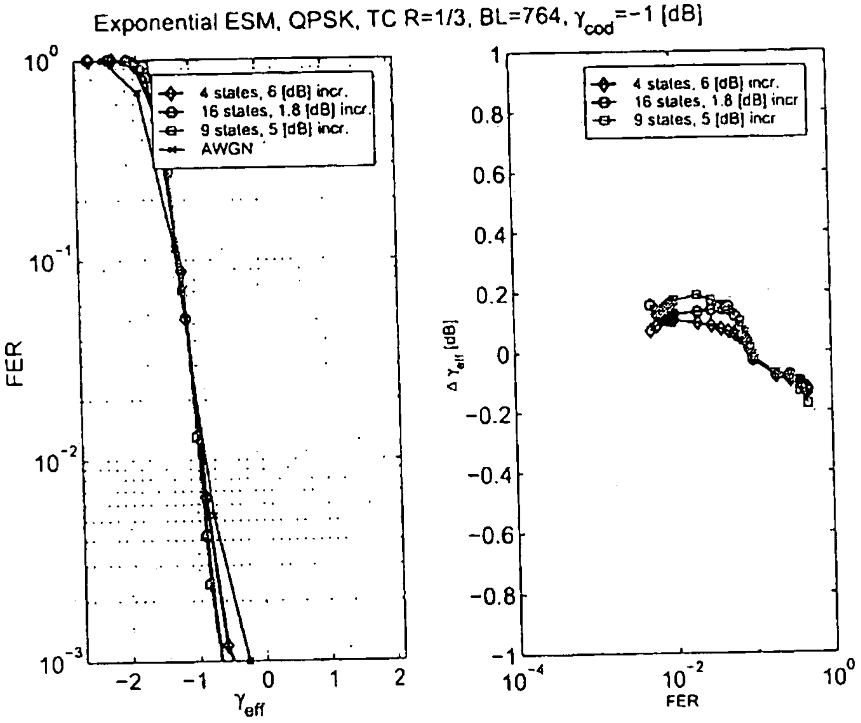
Exponential ESM, QPSK, TC R=1/3, BL=764, γ_{cod}=-1 [dB]
FER
10^{0}
10^{-1}
10^{-2}
10^{-3}
-2
-1
0
1
2
γ_{eff}
4 states, 6 [dB] incr.
16 states, 1.8 [dB] incr.
9 states, 5 [dB] incr.
AWGN
$\Delta\gamma_{eff}$ [dB]
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
10^{-4}
10^{-2}
10^{0}
FER
4 states, 6 [dB] incr.
16 states, 1.8 [dB] incr
9 states, 5 [dB] incr

Fig. 18

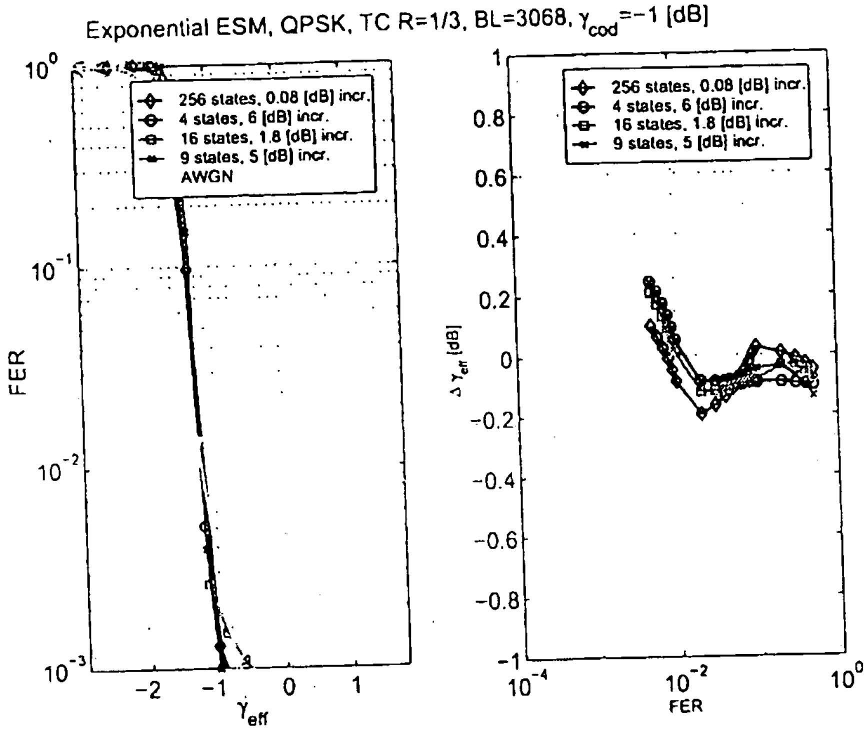
Exponential ESM, QPSK, TC R=1/3, BL=3068, γ_{cod}=-1 [dB]
256 states, 0.08 [dB] incr.
4 states, 6 [dB] incr.
16 states, 1.8 [dB] incr.
9 states, 5 [dB] incr.
AWGN
FER
10^0
10^{-1}
10^{-2}
10^{-3}
-2
-1
0
1
γ_{eff}
$\Delta\gamma_{eff}$ [dB]
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
10^{-4}
10^{-2}
10^0
FER

Fig. 19

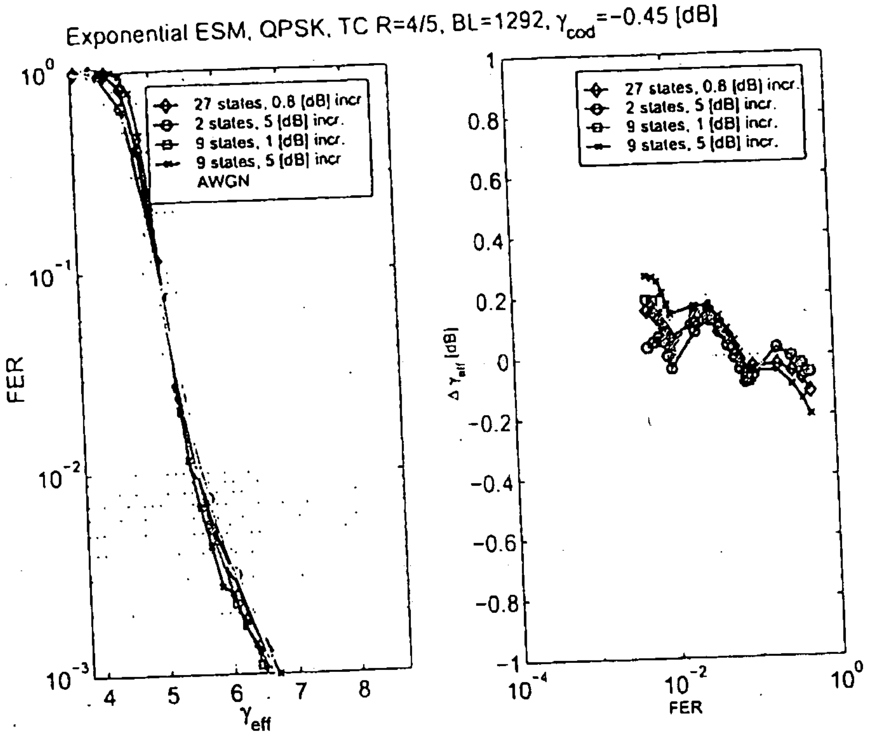
Exponential ESM, QPSK, TC R=4/5, BL=1292, γ_{cod}=-0.45 [dB]
FER
10^{0}
10^{-1}
10^{-2}
10^{-3}
4
5
6
7
8
γ_{eff}
27 states, 0.8 [dB] incr
2 states, 5 [dB] incr.
9 states, 1 [dB] incr.
9 states, 5 [dB] incr
AWGN
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
$\Delta\gamma_{eff}$ [dB]
10^{-4}
10^{-2}
10^{0}
FER
27 states, 0.8 [dB] incr.
2 states, 5 [dB] incr.
9 states, 1 [dB] incr.
9 states, 5 [dB] incr.

Fig. 20

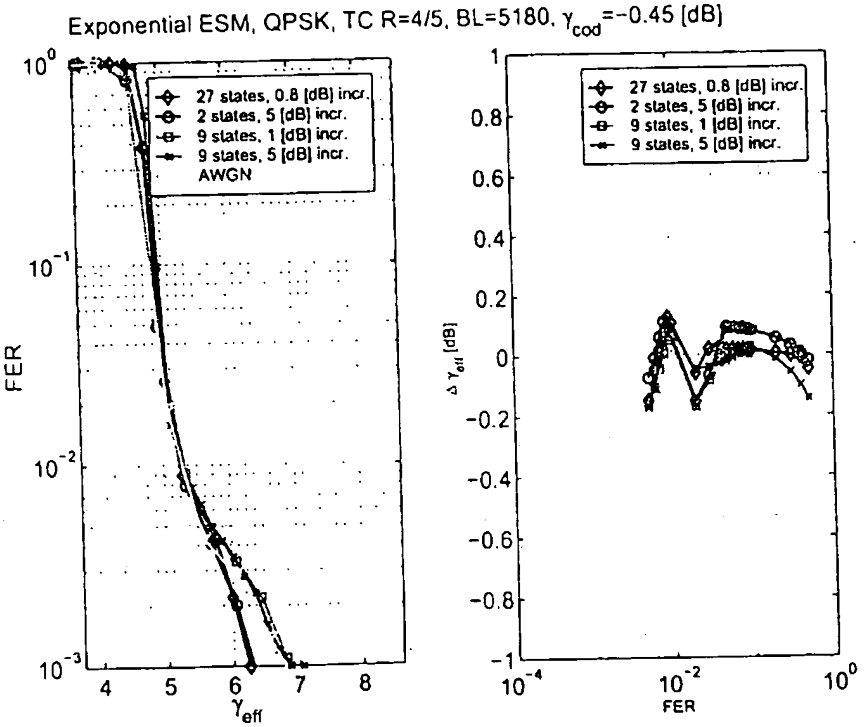
Exponential ESM, QPSK, TC R=4/5, BL=5180, γ_{cod}=-0.45 [dB]
FER
10^{0}
10^{-1}
10^{-2}
10^{-3}
4
5
6
7
8
γ_{eff}
27 states, 0.8 [dB] incr.
2 states, 5 [dB] incr.
9 states, 1 [dB] incr.
9 states, 5 [dB] incr.
AWGN
$\Delta\gamma_{eff}$ [dB]
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
10^{-4}
10^{-2}
10^{0}
FER

Fig. 21

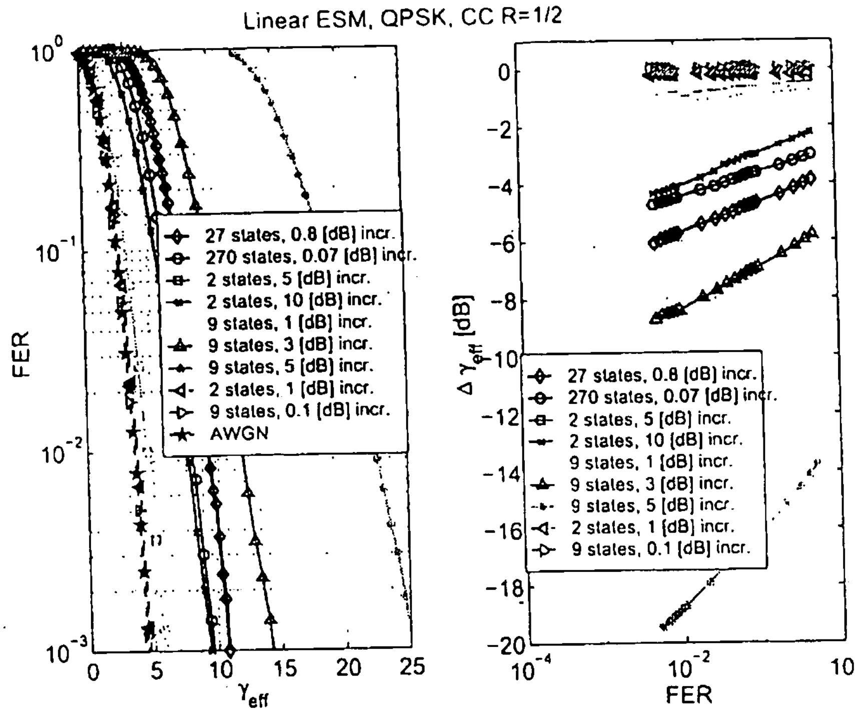
Linear ESM, QPSK, CC R=1/2
FER
10^0
10^{-1}
10^{-2}
10^{-3}
0
5
10
15
20
25
γ_{eff}
27 states, 0.8 [dB] incr.
270 states, 0.07 [dB] incr.
2 states, 5 [dB] incr.
2 states, 10 [dB] incr.
9 states, 1 [dB] incr.
9 states, 3 [dB] incr.
9 states, 5 [dB] incr.
2 states, 1 [dB] incr.
9 states, 0.1 [dB] incr.
AWGN
$\Delta\gamma_{eff}$ [dB]
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
10^{-4}
10^{-2}
10^0
FER

Fig.22

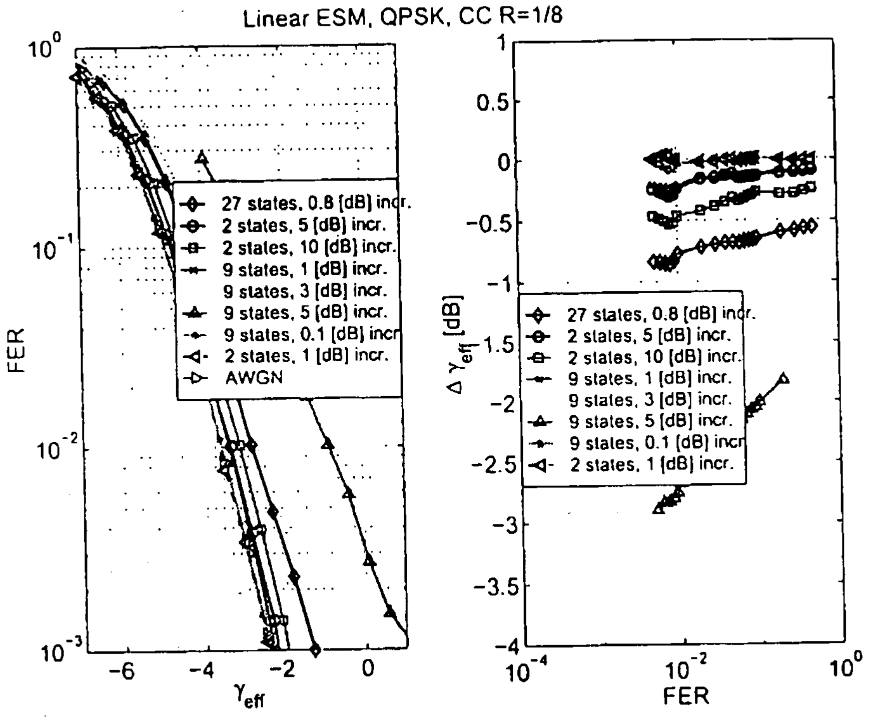
Linear ESM, QPSK, CC R=1/8
FER
10^0
10^-1
10^-2
10^-3
-6
-4
-2
0
γ_eff
27 states, 0.8 [dB] incr.
2 states, 5 [dB] incr.
2 states, 10 [dB] incr.
9 states, 1 [dB] incr.
9 states, 3 [dB] incr.
9 states, 5 [dB] incr.
9 states, 0.1 [dB] incr
2 states, 1 [dB] incr.
AWGN
Δ γ_eff [dB]
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
10^-4
10^-2
10^0
FER
27 states, 0.8 [dB] incr.
2 states, 5 [dB] incr.
2 states, 10 [dB] incr.
9 states, 1 [dB] incr.
9 states, 3 [dB] incr.
9 states, 5 [dB] incr.
9 states, 0.1 [dB] incr
2 states, 1 [dB] incr.

Fig. 23

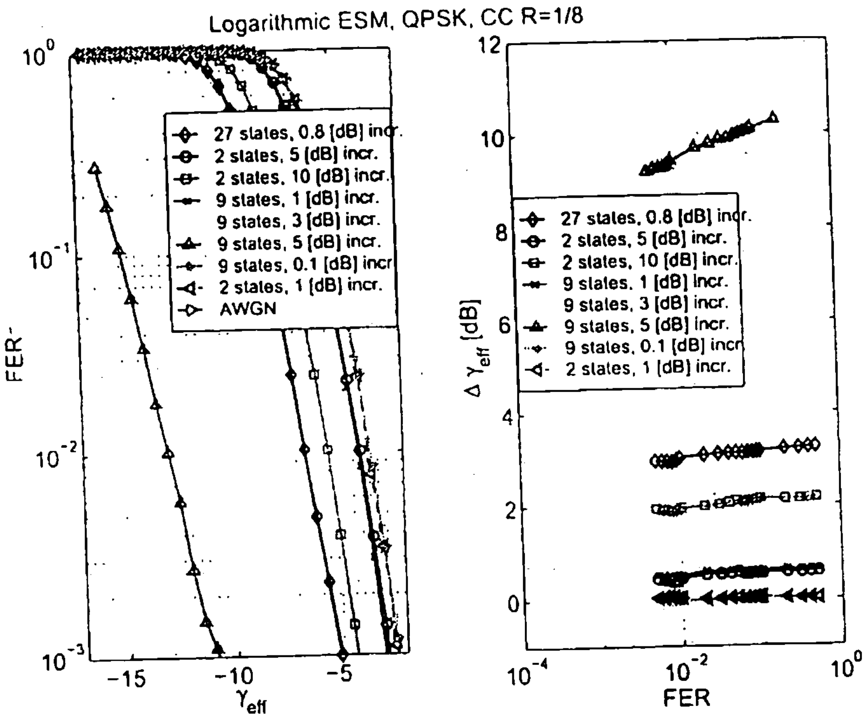
Logarithmic ESM, QPSK, CC R=1/8
10^0
10^{-1}
10^{-2}
10^{-3}
FER
-15
-10
-5
γ_{eff}
27 states, 0.8 [dB] incr.
2 states, 5 [dB] incr.
2 states, 10 [dB] incr.
9 states, 1 [dB] incr.
9 states, 3 [dB] incr.
9 states, 5 [dB] incr.
9 states, 0.1 [dB] incr
2 states, 1 [dB] incr.
AWGN
12
10
8
6
4
2
0
$\Delta\gamma_{eff}$ [dB]
10^{-4}
10^{-2}
10^0
FER
27 states, 0.8 [dB] incr.
2 states, 5 [dB] incr.
2 states, 10 [dB] incr.
9 states, 1 [dB] incr.
9 states, 3 [dB] incr.
9 states, 5 [dB] incr.
9 states, 0.1 [dB] incr
2 states, 1 [dB] incr.

Fig. 24

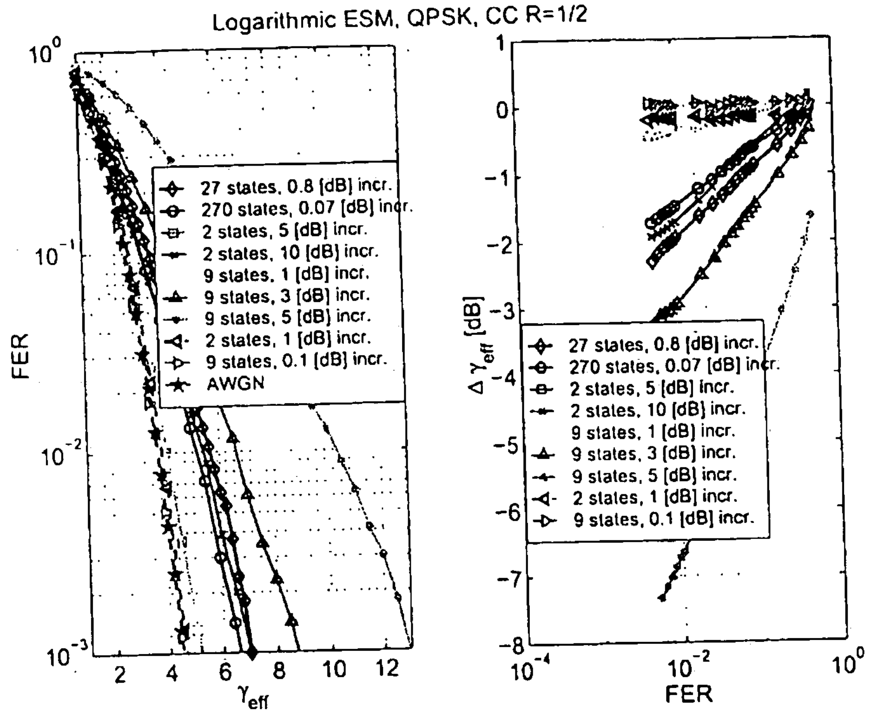
Logarithmic ESM, QPSK, CC R=1/2
FER
γ_{eff}
10^0
10^{-1}
10^{-2}
10^{-3}
2 4 6 8 10 12
27 states, 0.8 [dB] incr.
270 states, 0.07 [dB] incr.
2 states, 5 [dB] incr.
2 states, 10 [dB] incr.
9 states, 1 [dB] incr.
9 states, 3 [dB] incr.
9 states, 5 [dB] incr.
2 states, 1 [dB] incr.
9 states, 0.1 [dB] incr.
AWGN
$\Delta\gamma_{eff}$ [dB]
1 0 -1 -2 -3 -4 -5 -6 -7 -8
10^{-4}
10^{-2}
10^0
FER
27 states, 0.8 [dB] incr.
270 states, 0.07 [dB] incr.
2 states, 5 [dB] incr.
2 states, 10 [dB] incr.
9 states, 1 [dB] incr.
9 states, 3 [dB] incr.
9 states, 5 [dB] incr.
2 states, 1 [dB] incr.
9 states, 0.1 [dB] incr.

Fig. 25

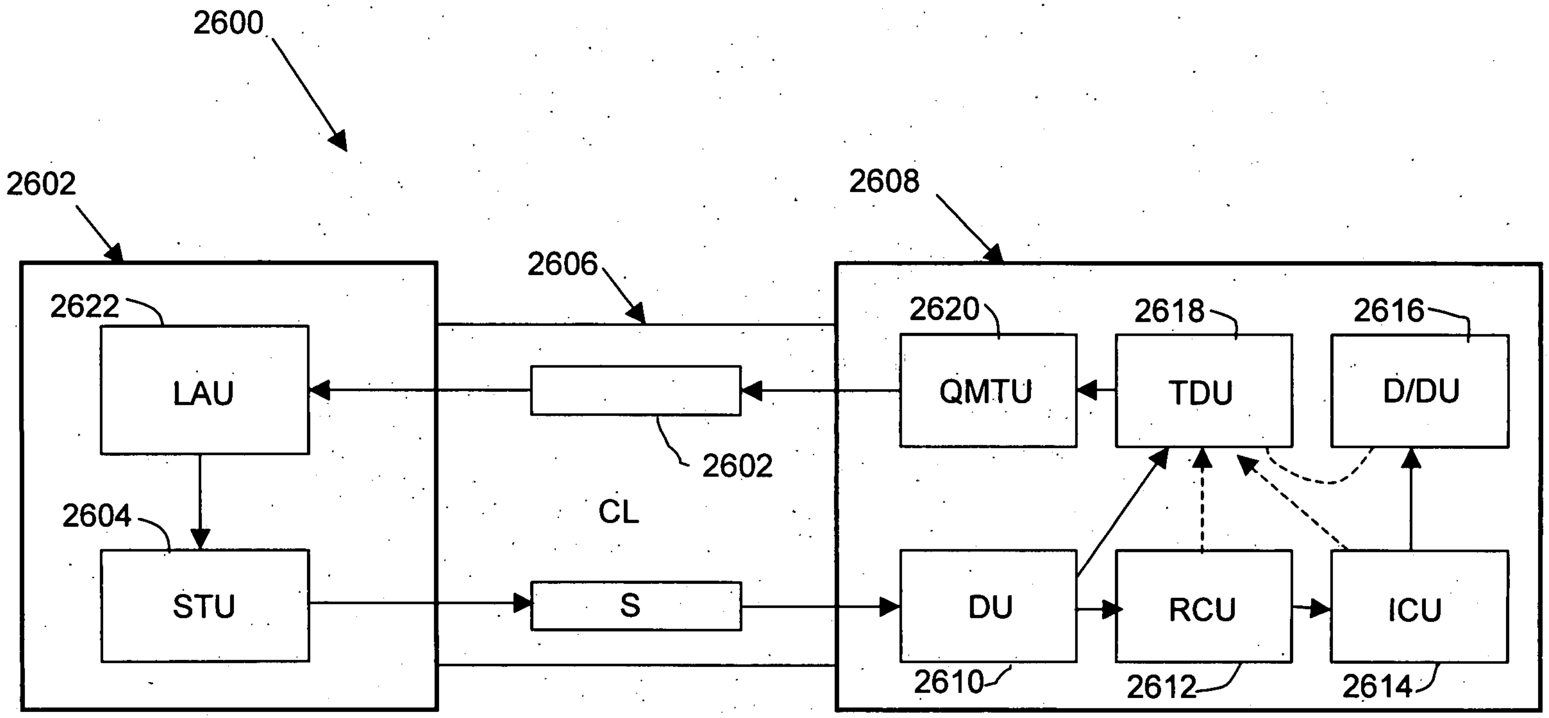
2600
2602
2608
2606
2622
LAU
2604
STU
2602
CL
S
2620
QMTU
2618
TDU
2616
D/DU
DU
2610
RCU
2612
ICU
2614

Fig. 26

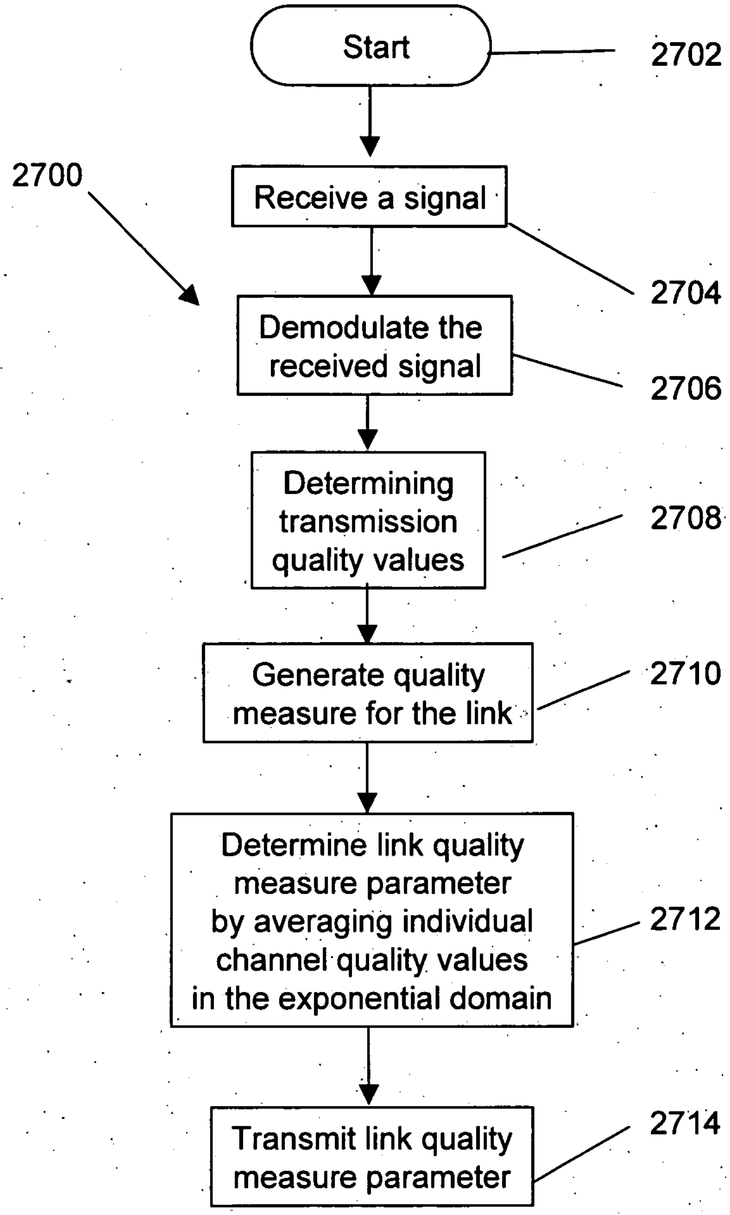
Start
2702
2700
Receive a signal
2704
Demodulate the received signal
2706
Determining transmission quality values
2708
Generate quality measure for the link
2710
Determine link quality measure parameter by averaging individual channel quality values in the exponential domain
2712
Transmit link quality measure parameter
2714

Fig. 27

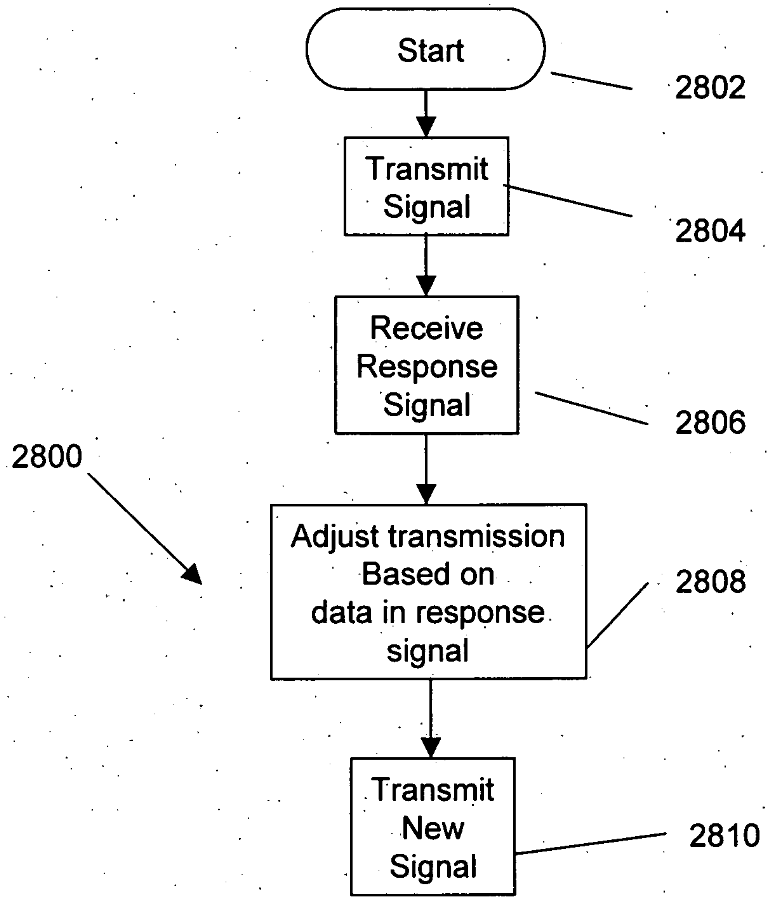
Start
2802
Transmit Signal
2804
Receive Response Signal
2806
2800
Adjust transmission Based on data in response signal
2808
Transmit New Signal
2810

Fig. 28